

Denne rapport  
tilhører

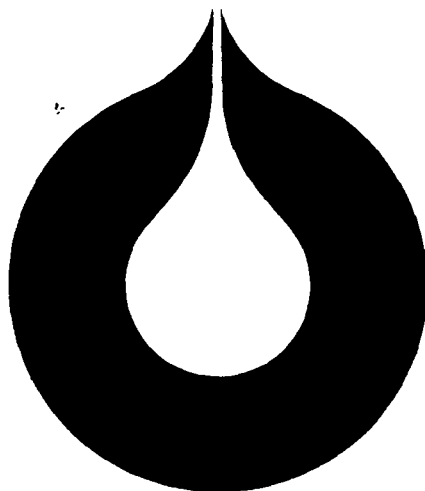
 **STATOIL**

**L&U DOK.SENTER**

L.NR. 30284070019

KODE WELL 31/2-5 NR. 53

Returneres etter bruk



**statoil**

Quick-look evaluation

Well: 31/2-5

Operasjonsteknologi - Stavanger

Statoil - January 1981

Engineer: J.I. Skagen

**Den norske stats oljeselskap a.s**

Quick-look evaluation

Well: 31/2-5

Operasjonsteknologi - Stavanger

Statoil - January 1981

Engineer: J.I. Skagen

## Preliminary petrophysical evaluation of 31/2-5

Two methods have been applied for this evaluation, the shaly sand method by using the Nigeria-equation and the Waxman - Smith method by using the cation - exchange - capacity theory.

The main problem with this evaluation is the high mica-content which effects the GR-log and the grain density.

No shale was observed in this reservoir and therefore the shale volume is set to zero.

Three zones of interest have been evaluated, the gas zone from 1535 to 1579 m RKB, the oil zone from 1579 to 1602 m RKB and the water zone from 1602 to 1610 m RKB.

Most of the parameters used for the evaluation are based on the 31/2-1 well.

The plots needed for the Waxman - Smith evaluation are based on 31/2-1 data.

## INPUT DATA

LOGS:            Laterolog Deep            (RLLD)  
                 Laterolog Shallow        (RLLS)  
                 Microspherical Focused Log (RXO)  
                 Formation Density Log    (RHOB)  
                 Compensated Neutron Log    (PHIN)  
                 Induction Log Deep (RILD) (RT)  
                 Gamma Ray Log            (GR)

Core data:      No core data is used.

## EVALUATION

The evaluation has been divided into the intervals:

1535 - 1579 m RKB ; gas zone  
1579 - 1602 m RKB ; oil zone  
1602 - 1610 m RKB ; water zone

The MSFL-log is used as RXO log. The RT log is evaluated by using:

RT = 1.7 RLLD - 0.7 RLLS in h.c. zones  
RT = RILD in water bearing zones

The shale content in this reservoir sand is very small and VSH is set to zero.

Micaceous sandstones: GR > 53,  $\gamma_G = 2.67$   
Clean sandstones: GR < 53,  $\gamma_G = 2.65$

Mud filtrate resistivity: Rmf = 0.07 (60 000 ppm)  
Formation water resistivity: Rw = 0.06 (70 000 ppm)  
Formation temperature: T = 125°F ?  
Gas density: 0.12  
Oil density: 0.7  
Water density: 1.045  
Mud filtrate density: 1.035

The final porosity (PHIF):

$$\phi = \frac{\rho_G - \text{RHOB}}{\rho_G - \rho_{fl}}$$

for all three zones, with different fluid densities. The fluid densities are found from several steps of SXO calculations (F = 8.5).

$$\text{SXO} = \sqrt{\frac{F \cdot \text{Rmf}}{\text{RXO}}}$$

Cut off values applied to this well:

$\phi$  > 24 % (i.e. k = 1 md)  
Vsh < 40 % (unimportant, Vsh = 0)  
Sw > 65 %

#### Nigeria formula exponents

Lithology factor (a) = 0.62  
Cementation exponent (m) = 2  
Saturation exponent (n) = 2

#### Waxman - Smith exponents

B-factor: 9.0 at 125°F 6.4 @ 101°F  
Saturation exponent (n) = 2  
F\* = A · (PHIF) EXP (-B)  
A = .532618  
B = -0.188956  
  
Qv = C (PHI) EXP (-E)  
C = .001495 0.0004  
E = -3.748 4.9

(see attached plots of data from 31/2-1).

Shaly sand evaluation

Nigeria equation

STATISTICS

FIELD: . . . . . BLOCK 3142  
 WELL: . . . . . 31-2-5  
 DATE: . . . . . 13.05.50 6 JANUARY 1981  
 ENGINEER: . . . . . JIS

DEPTH INTERVAL: . . . . 1535.00 TO 1602.00

APPLIED CUTOFFS:

. . . . . WCH: GREATER THAN 0.40  
 . . . . . PHIF: LESS THAN 0.24  
 . . . . . SW: GREATER THAN 0.65

TOTAL DEPTH

THICKNESS: . . . . . 57.000  
 AVERAGE . . . . . (PHIF) . . . . . 0.285  
 AVERAGE . . . . . (WHALE) . . . . . 0.000  
 AVERAGE . . . . . (SW) . . . . . 0.015  
 W.AVERAGE . . . . . (SW) \* (PHIF) . . . . . 0.015  
 AVERAGE . . . . . (WCH) . . . . . 0.985  
 VOID VOLUME: . . . . . (PHIF) . . . . . 19.069  
 HC VOID VOLUME . . . . . (WCH) \* . . . . . 18.789  
 RES HC VOID VOLUME (WCH) \* . . . . . 17.611  
 NOW HC VOID VOLUME . . . . . 1.172

NET PAY

THICKNESS: . . . . . 57.250  
 AVERAGE . . . . . (PHIF) . . . . . 0.306  
 AVERAGE . . . . . (WHALE) . . . . . 0.000  
 AVERAGE . . . . . (SW) . . . . . 0.015  
 W.AVERAGE . . . . . (SW) \* (PHIF) . . . . . 0.014  
 AVERAGE . . . . . (WCH) . . . . . 0.985  
 VOID VOLUME: . . . . . (PHIF) . . . . . 17.493  
 HC VOID VOLUME . . . . . (WCH) \* . . . . . 17.242  
 RES HC VOID VOLUME (WCH) \* . . . . . 16.154  
 NOW HC VOID VOLUME . . . . . 1.088

Total h.c. zone  
 1535 - 1602 m

NET SAND

THICKNESS: . . . . . 57.250  
 AVERAGE . . . . . (PHIF) . . . . . 0.306  
 AVERAGE . . . . . (WHALE) . . . . . 0.000  
 AVERAGE . . . . . (SW) . . . . . 0.015  
 W.AVERAGE . . . . . (SW) \* (PHIF) . . . . . 0.014  
 AVERAGE . . . . . (WCH) . . . . . 0.985  
 VOID VOLUME: . . . . . (PHIF) . . . . . 17.493  
 HC VOID VOLUME . . . . . (WCH) \* . . . . . 17.242  
 RES HC VOID VOLUME (WCH) \* . . . . . 16.154  
 NOW HC VOID VOLUME . . . . . 1.088

NET GROSS RATIOS

HNTPAY \* HGROSS SAND = 0.85448  
 HNTERAND \* HGROSS SAND = 0.85448  
 HNTPAY \* HNTERAND = 1.00000

STATISTICS

FIELD: . . . . . BLOCK 3142  
 WELL: . . . . . 31-2-5  
 DATE: . . . . . 13.16.24 6 JANUARY 1981  
 ENGINEER: . . . . . JIS

DEPTH INTERVAL: . . . . 1535.00 TO 1579.00

APPLIED CUTOFFS:

. . . . . VSH: GREATER THAN 0.40  
 . . . . . PHIF: LESS THAN 0.24  
 . . . . . SW: GREATER THAN 0.65

TOTAL DEPTH

THICKNESS: . . . . . 44.000  
 AVERAGE . . . . (PHIF) . . . . 0.276  
 AVERAGE . . . . (VSHALE) . . . . 0.000  
 AVERAGE . . . . (SW) . . . . 0.013  
 W.AVERAGE . . . (SW) \* (PHIF) . . . . 0.012  
 AVERAGE . . . . (SH) . . . . 0.987  
 VOID VOLUME: . . . . (PHIF) . . . . 12.141  
 HC VOID VOLUME . . . (SH) \* . . . . 11.993  
 RES HC VOID VOLUME (SH) \* . . . . 11.245  
 MOV HC VOID VOLUME . . . . . 0.748

NET PAY

Gas zone

1535 - 1579 m

THICKNESS: . . . . . 35.000  
 AVERAGE . . . . (PHIF) . . . . 0.306  
 AVERAGE . . . . (VSHALE) . . . . 0.000  
 AVERAGE . . . . (SW) . . . . 0.012  
 W.AVERAGE . . . (SW) \* (PHIF) . . . . 0.011  
 AVERAGE . . . . (SH) . . . . 0.988  
 VOID VOLUME: . . . . (PHIF) . . . . 10.715  
 HC VOID VOLUME . . . (SH) \* . . . . 10.595  
 RES HC VOID VOLUME (SH) \* . . . . 9.926  
 MOV HC VOID VOLUME . . . . . 0.669

NET SAND

THICKNESS: . . . . . 35.000  
 AVERAGE . . . . (PHIF) . . . . 0.306  
 AVERAGE . . . . (VSHALE) . . . . 0.000  
 AVERAGE . . . . (SW) . . . . 0.012  
 W.AVERAGE . . . (SW) \* (PHIF) . . . . 0.011  
 AVERAGE . . . . (SH) . . . . 0.988  
 VOID VOLUME: . . . . (PHIF) . . . . 10.715  
 HC VOID VOLUME . . . (SH) \* . . . . 10.595  
 RES HC VOID VOLUME (SH) \* . . . . 9.926  
 MOV HC VOID VOLUME . . . . . 0.669

NET / GROSS RATIOS

HNTPAY / HGROSS SAND = 0.79545  
 HNETSAND / HGROSS SAND = 0.79545  
 HNTPAY / HNETSAND = 1.00000



STATISTICS

FIELD: . . . . . BLOCK 3142  
 WELL: . . . . . 31-2-5  
 DATE: . . . . . 13.31.53 6 JANUARY 1951  
 ENGINEER: . . . . . JIS

DEPTH INTERVAL: . . . . 1579.00 TO 1602.00

APPLIED CUTOFFS:

. . . . . VCH: GREATER THAN 0.40  
 . . . . . PHIF: LESS THAN 0.24  
 . . . . . DM: GREATER THAN 0.65

TOTAL DEPTH

THICKNESS: . . . . . 23.000  
 AVERAGE . . . . PHIF . . . . 0.301  
 AVERAGE . . . . VCHALE . . . . 0.000  
 AVERAGE . . . . DM . . . . 0.020  
 W.AVERAGE . . . . DM \* PHIF . . . . 0.019  
 AVERAGE . . . . CH . . . . 0.980  
 VOID VOLUME: . . . . (PHIF \* L) . . . . 6.928  
 HC VOID VOLUME . . . . (CH \* L) . . . . 6.796  
 RES HC VOID VOLUME (CH \* L) . . . . 6.366  
 MOV HC VOID VOLUME . . . . . 0.431

NET PAY

THICKNESS: . . . . . 22.250  
 AVERAGE . . . . PHIF . . . . 0.305  
 AVERAGE . . . . VCHALE . . . . 0.000  
 AVERAGE . . . . DM . . . . 0.020  
 W.AVERAGE . . . . DM \* PHIF . . . . 0.019  
 AVERAGE . . . . CH . . . . 0.980  
 VOID VOLUME: . . . . (PHIF \* L) . . . . 6.778  
 HC VOID VOLUME . . . . (CH \* L) . . . . 6.647  
 RES HC VOID VOLUME (CH \* L) . . . . 6.228  
 MOV HC VOID VOLUME . . . . . 0.419

Oil zone  
 1579 - 1602 m

NET SAND

THICKNESS: . . . . . 22.250  
 AVERAGE . . . . PHIF . . . . 0.305  
 AVERAGE . . . . VCHALE . . . . 0.000  
 AVERAGE . . . . DM . . . . 0.020  
 W.AVERAGE . . . . DM \* PHIF . . . . 0.019  
 AVERAGE . . . . CH . . . . 0.980  
 VOID VOLUME: . . . . (PHIF \* L) . . . . 6.778  
 HC VOID VOLUME . . . . (CH \* L) . . . . 6.647  
 RES HC VOID VOLUME (CH \* L) . . . . 6.228  
 MOV HC VOID VOLUME . . . . . 0.419

NET SAND TO OIL RATIO

HNETPAY / HGRDSD SAND = 0.96739  
 HNETSAND / HGRDSD SAND = 0.96739  
 HNETPAY / HNETSAND = 1.00000

Waxman - Smith evaluation

Cation - exchange - capacity

31/2-1

$$Q_v = a \cdot \phi^{-b}$$

Sample no.	Porosity	Qv
2	.341	0.06
8	.309	0.12
14	.380	0.05
17	<u>.287</u>	0.23
19	<u>.323</u>	0.02
21	<u>.358</u>	0.10
22	<u>.248</u>	0.25
24	<u>.292</u>	0.13

Linear regression:  $a = 14.915 \times 10^{-4}$   
 $b = -3.748$

$$F^* = F (1 + R_w \cdot B \cdot Q_v)$$

$$R_w = 0.06$$

$$B = 9 \text{ at } 125^\circ\text{F}$$

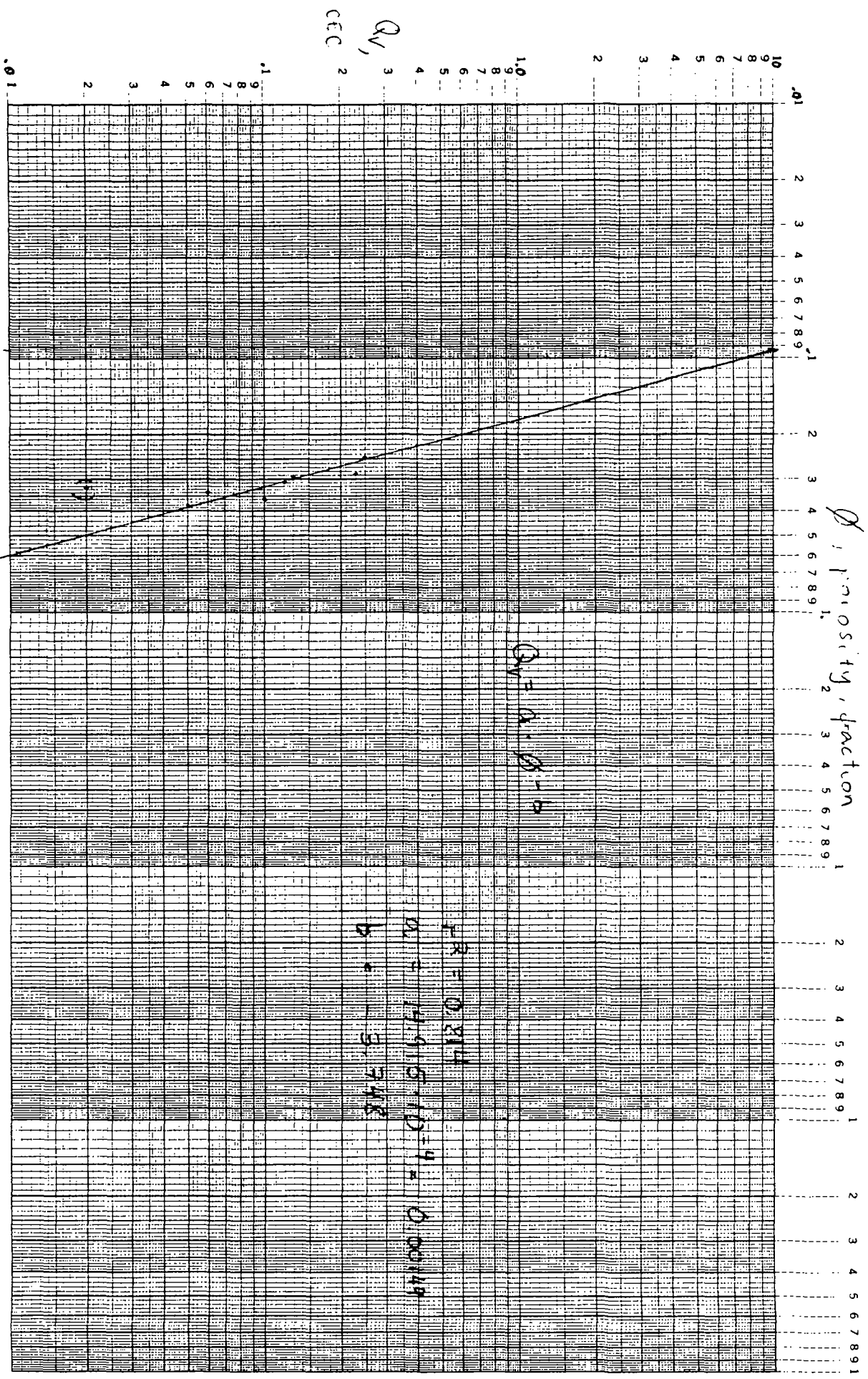
Qv	F	F*	$\phi$ , Porosity
0.0623	6.4	6.615	0.3659
0.0958	14.3	15.040	0.3294
0.1028	13.3	14.039	0.3232
0.0621	6.4	6.615	0.3698
0.1616	20.6	22.397	<u>0.2865</u>
0.0852	13.2	13.808	0.3398
0.1025	12.0	12.664	<u>0.3235</u>
0.0865	11.2	11.723	0.3385
0.2787	21.6	24.851	<u>0.2477</u>
0.1510	21.0	22.713	<u>0.2917</u>

$$F^* = a \cdot \phi^{-m}$$

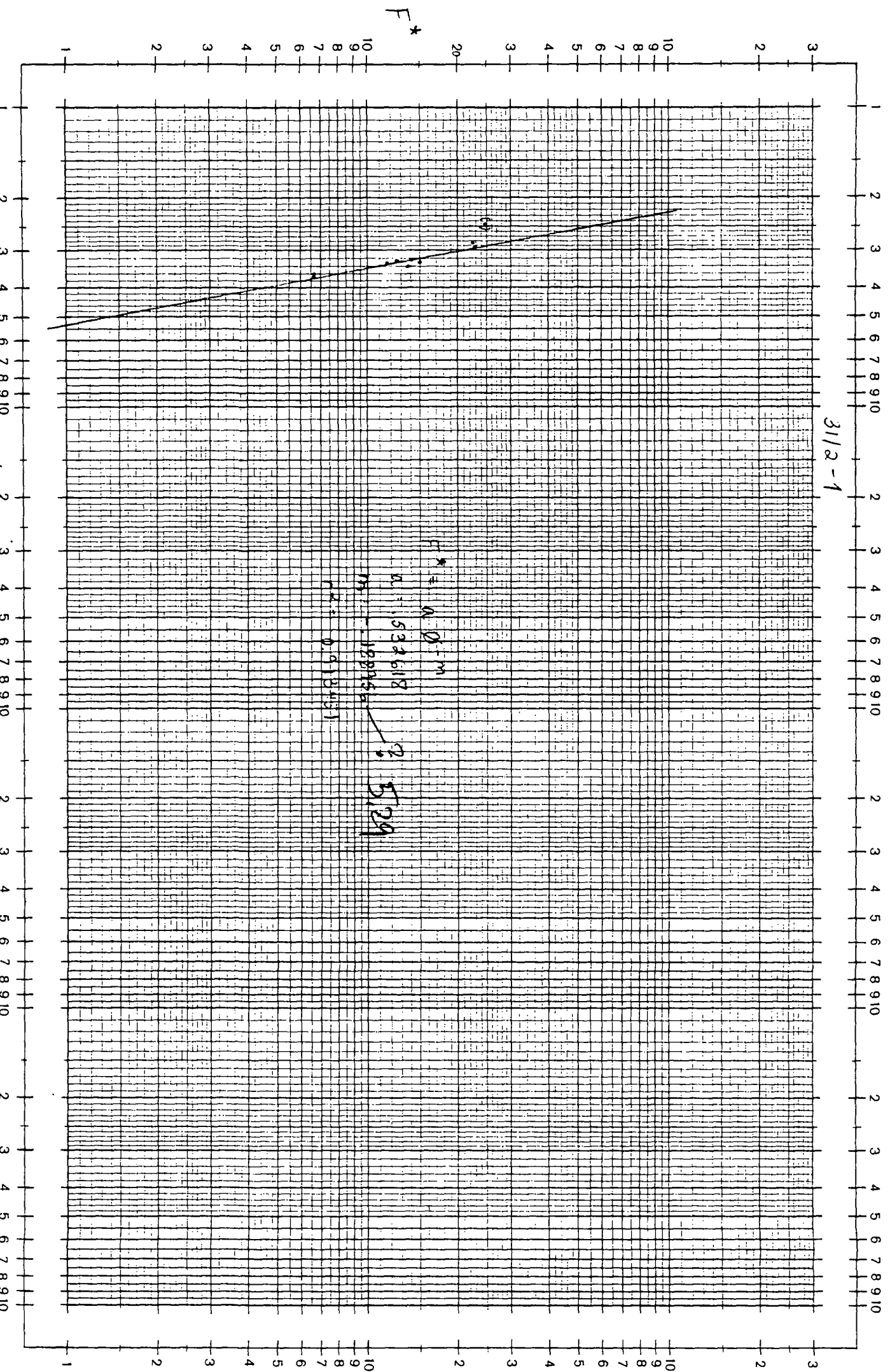
Linear regression:  $a = .532618$   
 $m = -0.188956$

31/2-1

Q, porosity, fraction



31/2-1



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Bestell-Nr. 667152, Nr. 369 1/2-1 MADE IN GERMANY

Beide Achsen logar. geteilt von 1 bis 10000 und 1 bis 300 Einheit 62,5 mm

BRONN  
31-2-5

DYBDE 1  
1535.00

DYBDE 2  
1610.00

THIS IS THE CALCULATION OF SM  
USING THE MAXMAN-SMITS METHOD

\*\*\*\*\*

GIVE SATURATION EXPONENT N: 72.0

GIVE THE FACTOR B: 79.0

GIVE A IN THE RELATION  $F=A \cdot (\Phi)^B \cdot \exp(-B)$ :

7.532618

GIVE B IN THE SAME RELATION: ?-.188956

GIVE RESISTIVITY OF FORMATION WATER: 7.06

IS CURVE QV ALREADY CALCULATED (YES/NO): ?NO

GIVE CONST C IN  $QV=C \cdot (\Phi)^E \cdot \exp(-E)$ : ?7.0014915

GIVE THE EXPONENT E: ?-3.748

SM-SH ARE FINISHED

STATISTICS

FIELD: . . . . . BLOCK 31/2  
 WELL: . . . . . 31-2-5  
 DATE: . . . . . 13.59.44 6 JANUARY 1981  
 ENGINEER: . . . . . JIS

DEPTH INTERVAL: . . . 1535.00 TO 1602.00

APPLIED CUTOFFS:

. VSH: GREATER THAN 0.40  
 . PHIF: LESS THAN 0.24  
 . SM: GREATER THAN 0.65

TOTAL DEPTH

THICKNESS: . . . . . 57.000  
 AVERAGE . . . (PHIF) . . . 0.285  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SM) . . . 0.082  
 W.AVERAGE . . (SM) \* (PHIF) . . 0.072  
 AVERAGE . . . (SH) . . . 0.918  
 VOID VOLUME: . . . (PHIF) . . . 19.069  
 HC VOID VOLUME . . (SH) \* . . . 17.700  
 RES HC VOID VOLUME (SHR) \* . . . 12.340  
 MOV HC VOID VOLUME . . . . . 5.360

NET PAY

THICKNESS: . . . . . 57.250  
 AVERAGE . . . PHIF . . . 0.306  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SM) . . . 0.067  
 W.AVERAGE . . (SM) \* (PHIF) . . 0.065  
 AVERAGE . . . (SH) . . . 0.933  
 VOID VOLUME: . . . (PHIF) . . . 17.493  
 HC VOID VOLUME . . (SH) \* . . . 16.364  
 RES HC VOID VOLUME (SHR) \* . . . 11.687  
 MOV HC VOID VOLUME . . . . . 4.677

Total h.c. zone  
 1535 - 1602 m

NET SAND

THICKNESS: . . . . . 57.250  
 AVERAGE . . . (PHIF) . . . 0.306  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SM) . . . 0.067  
 W.AVERAGE . . (SM) \* (PHIF) . . 0.065  
 AVERAGE . . . (SH) . . . 0.933  
 VOID VOLUME: . . . (PHIF) . . . 17.493  
 HC VOID VOLUME . . (SH) \* . . . 16.364  
 RES HC VOID VOLUME (SHR) \* . . . 11.687  
 MOV HC VOID VOLUME . . . . . 4.677

NET/GROSS RATIOS

NETPAY / HGROSS SAND = 0.85448  
 NETSAND / HGROSS SAND = 0.85448  
 NETPAY / NETSAND = 1.00000

STATISTICS

FIELD: . . . . . BLOCK 31/2  
 WELL: . . . . . 31-2-5  
 DATE: . . . . . 14.33.05 6 JANUARY 1981  
 ENGINEER: . . . . . JIS

DEPTH INTERVAL: . . . . 1535.00 TO 1579.00  
 APPLIED CUTOFFS:

. VSH: GREATER THAN 0.40  
 . PHIF: LESS THAN 0.24  
 . SW: GREATER THAN 0.65

TOTAL DEPTH

THICKNESS: . . . . . 44.000  
 AVERAGE . . . (PHIF) . . . . 0.276  
 AVERAGE . . . (VSHALE) . . . . 0.000  
 AVERAGE . . . (SW) . . . . . 0.077  
 W.AVERAGE . . (SW) \* (PHIF) . . 0.063  
 AVERAGE . . . (SH) . . . . . 0.923  
 VOID VOLUME: . . . (PHIF) . . . 12.141  
 HC VOID VOLUME . . (SH) \* . . . . 11.375  
 RES HC VOID VOLUME (SH) \* . . . . 7.881  
 MOV HC VOID VOLUME . . . . . 3.494

NET PAY

THICKNESS: . . . . . 35.000  
 AVERAGE . . . (PHIF) . . . . 0.306  
 AVERAGE . . . (VSHALE) . . . . 0.000  
 AVERAGE . . . (SW) . . . . . 0.052  
 W.AVERAGE . . (SW) \* (PHIF) . . 0.050  
 AVERAGE . . . (SH) . . . . . 0.948  
 VOID VOLUME: . . . (PHIF) . . . 10.715  
 HC VOID VOLUME . . (SH) \* . . . . 10.181  
 RES HC VOID VOLUME (SH) \* . . . . 7.291  
 MOV HC VOID VOLUME . . . . . 2.890

Gas zone  
 1535 - 1579 m

NET SAND

THICKNESS: . . . . . 35.000  
 AVERAGE . . . (PHIF) . . . . 0.306  
 AVERAGE . . . (VSHALE) . . . . 0.000  
 AVERAGE . . . (SW) . . . . . 0.052  
 W.AVERAGE . . (SW) \* (PHIF) . . 0.050  
 AVERAGE . . . (SH) . . . . . 0.948  
 VOID VOLUME: . . . (PHIF) . . . 10.715  
 HC VOID VOLUME . . (SH) \* . . . . 10.181  
 RES HC VOID VOLUME (SH) \* . . . . 7.291  
 MOV HC VOID VOLUME . . . . . 2.890

NET / GROSS RATIOS

HNETPAY / HGROSS SAND = 0.79545  
 HNETSAND / HGROSS SAND = 0.79545  
 HNETPAY / HNETSAND = 1.00000



STATISTICS

FIELD: . . . . . BLOCK 31-2  
 WELL: . . . . . 31-2-5  
 DATE: . . . . . 14.46.41 6 JANUARY 1981  
 ENGINEER: . . . . . JID

DEPTH INTERVAL: . . . 1579.00 TO 1602.00  
 APPLIED CUTOFFS:

. VSH: GREATER THAN 0.40  
 . PHIF: LESS THAN 0.24  
 . SM: GREATER THAN 0.65

TOTAL DEPTH

THICKNESS: . . . . . 23.000  
 AVERAGE . . . (PHIF) . . . 0.301  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SM) . . . 0.091  
 W.AVERAGE . . . (SM) \* (PHIF) . . . 0.087  
 AVERAGE . . . (SH) . . . 0.909  
 VOID VOLUME: . . . (PHIF) . . . 6.928  
 HC VOID VOLUME . . . (SH) \* . . . 6.325  
 RES HC VOID VOLUME (SHR) \* . . . 4.459  
 MOV HC VOID VOLUME . . . . . 1.866

NET PAY

THICKNESS: . . . . . 22.250  
 AVERAGE . . . (PHIF) . . . 0.305  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SM) . . . 0.092  
 W.AVERAGE . . . (SM) \* (PHIF) . . . 0.088  
 AVERAGE . . . (SH) . . . 0.908  
 VOID VOLUME: . . . (PHIF) . . . 6.778  
 HC VOID VOLUME . . . (SH) \* . . . 6.184  
 RES HC VOID VOLUME (SHR) \* . . . 4.396  
 MOV HC VOID VOLUME . . . . . 1.788

Oil zone  
 1579 - 1602 m

NET SAND

THICKNESS: . . . . . 22.250  
 AVERAGE . . . (PHIF) . . . 0.305  
 AVERAGE . . . (VSHALE) . . . 0.000  
 AVERAGE . . . (SM) . . . 0.092  
 W.AVERAGE . . . (SM) \* (PHIF) . . . 0.088  
 AVERAGE . . . (SH) . . . 0.908  
 VOID VOLUME: . . . (PHIF) . . . 6.778  
 HC VOID VOLUME . . . (SH) \* . . . 6.184  
 RES HC VOID VOLUME (SHR) \* . . . 4.396  
 MOV HC VOID VOLUME . . . . . 1.788

NET/GROSS RATIOS

HNETPAY / HGROSS SAND = 0.26739  
 HNETSAND / HGROSS SAND = 0.26739  
 HNETPAY / HNETSAND = 1.00000